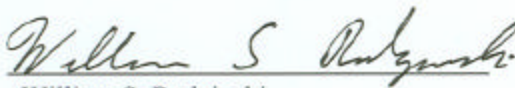





CRITERION 601
CRANES, HOISTS, LIFTING DEVICES, AND RIGGING

SIGNATURES

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RECORD OF REVISIONS

Revision No.	Date	Description
0	12/17/98	Initial Issue
1	03/01/05	This revision incorporates the formatting in Revision 3 of O&M Criterion Writer's Guide.
	03/01/05	Update maintenance and operator qualification requirements
	03/01/05	Incorporate Lessons Learned in crane strike of 113.2 kV overhead power line during transport

TABLE OF CONTENTS

1.0	PURPOSE.....	3
2.0	SCOPE.....	3
3.0	ACRONYMS AND DEFINITIONS.....	4
3.1	Acronyms	4
3.2	Definitions	4
4.0	RESPONSIBILITIES	7
4.1	FM – Maintenance and System Engineering (MSE).....	7
4.2	Facility Manager.....	7
4.3	Group Leader	7
4.4	Authority Having Jurisdiction (AHJ) - POC for Mechanical Chapter of LANL Engineering Manual	8
5.0	PRECAUTIONS AND LIMITATIONS	8
5.1	Precautions	8
5.2	Limitations	9
6.0	REQUIREMENTS	9
6.1	Operator Requirements	9
6.2	Inspector Requirements	10
6.3	Operations Requirements	10
6.4	Maintenance Requirements	11
7.0	RECOMMENDATIONS AND GOOD PRACTICES	12
7.1	Operations Recommendations	12
7.2	Maintenance Recommendations	12
8.0	Guidance	12
8.1	Operations Guidance	12
8.2	Maintenance Guidance	12
9.0	REQUIRED DOCUMENTATION.....	13
9.1	General Records	13
10.0	REFERENCES	14
11.0	APPENDICES	15

CRITERION 601

CRANES, HOISTS, LIFTING DEVICES, AND RIGGING

1.0 PURPOSE

The purpose of this Criterion is to establish the minimum requirements and best practices for operation and maintenance of Cranes, Hoists, Lifting Devices, and Rigging at LANL.

This document addresses the requirements of LIR 230-05-01(Ref 10.1), “Operations and Maintenance Manual.”

Implementation of this Criterion satisfies DOE Order 433.1 (Ref 10.3) for the subject equipment / system. DOE Order 430.1A (Ref 10.2) “Life Cycle Asset Management,” Attachment 2 “Contractor Requirements Document,” Paragraph 2, Sections A through C, which in part requires UC to “...maintain physical assets in a condition suitable for their intended purpose,” and employ “preventive, predictive, and corrective maintenance to ensure physical asset availability for planned use and/or proper disposition.” Compliance with DOE Order 430.1A is required by Appendix G of the UC Contract.

2.0 SCOPE

The scope of this Criterion includes operator certification and training, operations, and inspection, testing, preventive maintenance of Cranes, Hoists, Lifting Devices, and Rigging. This Criterion does not address corrective maintenance actions required to repair or replace equipment.

Specific equipment covered by this Criterion includes Overhead and Gantry Cranes, Slings, Articulating Boom Cranes, Monorails and Underhung Cranes, Mobile Cranes, Forklift Trucks, and Hoists. Engine and/or motor maintenance of Mobile Cranes and Forklift Trucks is not covered in this Criterion. Electric Motor maintenance is addressed in Criterion 510.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

3.0 ACRONYMS AND DEFINITIONS

3.1 Acronyms

AHJ	Authority Having Jurisdiction
CFR	Code of Federal Regulations
DOE	Department of Energy
LIG	Laboratory Implementing Guidance
LIR	Laboratory Implementing Requirement
LPR	Laboratory Performance Requirement
O&M	Operations and Maintenance
PPE	Personal Protective Equipment
PP&PE	Personal Property and Programmatic Equipment
RP&IE	Real Property and Installed Equipment
SSC	Structures, Systems, and Components
PIC	Person in Charge
ASME	American Society of Mechanical Engineers

3.2 Definitions

Corrective Maintenance. The repair of defective, failed, or malfunctioning units, or equipment to restore the intended function, or design condition. This form of maintenance may not result in a significant extension of the expected useful life.

Formally Removed From Active Service. Units locked and tagged out of service and de-energized, or locked away, tagged not to be used, and removed from the active service list.

Frequent Use. The continuous, daily, or weekly use of a unit within its design parameters.

Below-hook Lifting Device. A device used in lifting/lowering operations that, used singularly or in combination, alters or transfers the direction or sequence of loading from the lifting device to the load.

Certified or licensed. Possessing a license or certificate issued by a recognized authority attesting that a worker has been trained and/or tested and is competent and qualified to perform specific tasks or operate specific equipment.

Cone of safety. An area in which personnel and equipment are separated from a hoisted load by distance.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

Guidance Note: Physical barricades, posting, or continuous monitoring may be used to designate the area.

Critical Lift. (also known as a high-consequence lift). Parts, components, assemblies, or lifting operations designated by the management or customer that, if involved in an accident, could present a significant risk of personal injury or property damage:

- cause a release of significant amounts of hazardous material;
- cause undetectable damage resulting in future operational or safety concerns at a facility; or
- cause an unacceptable operational or programmatic impact.

Guidance Note: The following should be considered for designating a critical lift:

- Any lift exceeding 75% of the manufacturer's rated capacity for the crane, hoist, or mechanized equipment to be used in the lift.
- Any item that requires special care in handling because of weight, size, asymmetrical shape, undetermined center of gravity, installation tolerances, or other unusual factors.
- Any lift using two or more cranes, hoists, pieces or mechanized equipment, or a combination of such equipment.
- An otherwise non-critical lift that must be made in close proximity to critical or expensive items which could be damaged as a result of contact with a hoisted load.
- Any lift where the crane, hoist, or mechanized equipment could at any time come in contact with an energized high voltage power line.
- Any lift that requires personnel to be hoisted.

Critical Lift Plan. A written document that contains elements outlined in Section 6.1.2 of LIR 402-1120-01.1.

Defect. Any characteristic or condition that may weaken or reduce the strength of a material or object of which it is a part.

General purpose installed lifting device (GPILD). Cranes and hoists installed as part of the original building construction or commercially available cranes and hoists that are attached to a building or other structure.

High Voltage. All voltages of 600 volts or greater, unless otherwise defined in the text of this LIR.

Hoist. A powered or manual device used to raise and lower a load. A hoist may be fixed or an integral part of a crane mechanism.

Hoisting. Any operation using powered or mechanical lifting devices such as chain falls, tuggers, shop cranes, mobile cranes, forklifts, wheel or track loaders, or hoists to raise or lower personnel, equipment, or materials.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

Incidental Crane Operator. A person who is certified to operate overhead cranes and hoists in routine work activities for ordinary lifts that are usually of low weight relative to the crane's rated capacity.

Guidance Note: Routine work activities do not include critical lifts or operation of mobile cranes.

Mobile Crane. A machine with a mechanism for travel that allows loads to be lifted and swung at various radii. Mobile cranes include crawler cranes, wheel-mounted truck or self-propelled cranes, and other cranes with similar characteristics.

Mobile Crane Operator. A person who is certified to operate mobile cranes who has successfully completed the training for mobile crane operators and has met the experience requirements listed in Section 5.2 or a person that possesses a current New Mexico State License under the Hoisting Operators Safety Act.

Non-Installed Lifting Device (NILD) – Commercially available or laboratory-built lifting devices such as come-alongs, chain falls, tuggers, shop cranes, block and tackle devices, and specially built onsite devices that are used to lift or lower equipment or materials.

Ordinary Lift – Any lift that does not meet the criteria of a critical lift and is not required to be documented unless a determination is made by personnel responsible for the lift that it should be documented as outlined in LIR 402-1120-01.1, Section 6.1.1.

Overhead Crane. A machine that uses a hoist and rigging to lift, lower, or horizontally move a load. Overhead cranes include overhead bridge, monorail, and jib cranes.

Person-in-Charge. The responsible person appointed by the owning Division Group Leader for the safe handling of critical loads and for the safe handling of non-critical items in, around, or above spaces in which critical items are located and is trained as a qualified crane operator and rigger.

Qualified Person. One who possesses a recognized degree, certificate, or professional standing or has extensive knowledge, training, and experience in a related or applicable field, and who has successfully demonstrated his/her ability to solve or resolve complex issues related to the subject matter, the work, or the project.

Qualified Crane Operator. A person certified or licensed to operate all types of overhead cranes and hoists.

Guidance Note: A qualified crane operator may perform the duties of the PIC for critical lifts, although he/she shall not operate equipment during the critical lift.

Designated Leader. The responsible person designated for each project who is responsible for all aspects of an Ordinary Lift and who is trained as an incidental crane operator, qualified crane operator or a rigger.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

Rigger. A person who is authorized to inspect rigging equipment, performs the tasks associated with hoisting and rigging operations and has at a minimum completed the incidental crane operators and rigging safety course.

Rigging. Wire rope slings, alloy steel chains, synthetic rope or web slings, shackles, eyebolts, and special devices, such as below-hook lifting devices that are used either singularly or in combination to attach a load to a lifting device.

Safety factor. The ratio of the ultimate breaking strength of a member or piece of material or equipment to the actual working stress or safe working load when in use.

4.0 RESPONSIBILITIES

4.1 FM – Maintenance and System Engineering (MSE)

4.1.1 FM-MSE is responsible for the technical content of this Criterion and monitoring the applicability and the implementation status of this Criteria and either assisting the organizations that are not applying or meeting the implementation expectations contained herein or elevating their concerns to the director(s).

Basis: LIR 301-00-01.13; Issuing and Managing Laboratory Operations Implementation Requirements and Guidance, Section 5.4, OIC Implementation Requirements.

4.1.2 FM-MSE shall provide technical assistance to support implementation of this Criterion.

4.2 Facility Manager

4.2.1 Responsible for operations and maintenance of institutional, or Real Property and Installed Equipment (RP&IE) under their jurisdiction, in accordance with the requirements of this document.

4.2.2 Responsible for operations and maintenance of those Personal Property and Programmatic Equipment (PP&PE) systems and equipment addressed by this document that may be assigned to the FM in accordance with the FMU-specific Facility/Tenant Agreement.

4.3 Group Leader

4.3.1 Responsible for implementing operational and maintenance surveillance programs including the preparation and maintenance of required procedures and documentation for PP&PE under their jurisdiction that is covered by this Criterion.

Responsible for the following:

- Identify in writing (by name and Z Number) the Incidental or Qualified Crane Operator, and Rigger, Mobile Crane Operator for hoisting and rigging operations.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

- Ensure that the safety training requirements for hoisting and rigging operations are current for employee qualification.
- Ensure that equipment defined in this criterion is correctly designed, certified, inspected and maintained prior to being used for hoisting and rigging operations.
- Appoint a person-in-charge (PIC) for critical lifts and a designated leader for ordinary lifts.
- Inform affected employees of the existence, location, and dangers posed by hoisting and rigging operations.
- Be knowledgeable concerning the determining factors of a critical lift.

Basis: LIR 402-1120-01.1 Cranes, Hoists, Lifting Devices, and Rigging Equipment

4.4 Authority Having Jurisdiction (AHJ) - POC for Mechanical Chapter of LANL Engineering Manual

4.4.1 Responsible for providing a decision on a specific technical question regarding national, state, and local codes, standards, and DOE Orders.

5.0 PRECAUTIONS AND LIMITATIONS

5.1 Precautions

This section is not intended to identify all applicable precautions necessary for implementation of this Criterion. A compilation of all applicable precautions shall be contained in the implementing procedure(s) or work control authorization documents. The following precautions are intended only to assist the author of a procedure or work control document in the identification of hazards/precautions that may not be immediately obvious.

5.1.1 ASME B30 series of standards and DOE-STD-1090-2004 (DOE Hoisting and Rigging Manual) list the following precautions when performing maintenance.

1. Move crane or monorail carrier to a location where it will cause the least interference with other cranes and operations.
2. Place loads on ground or floor
3. Place all controllers in the off position
4. Perform a lockout/tagout procedure.
5. Use warning signs and barriers on the floor beneath the crane.

5.1.2 Transportation of oversized conventional cranes over LANL and State/County roads requires hazard analysis for oversize/overweight load, traffic obstruction, and vertical clearance of overhead hazards. Direct communication between crane driver and crane operator is mandatory.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

Lesson Learned: February 26, 2004, near miss to a fatality. Crane strikes 13.2kV overhead power line during transport.

5.2 Limitations

The intent of this Criterion is to identify the minimum generic requirements and recommendations for SSC operation and maintenance across the Laboratory. Each user is responsible for the identification and implementation of additional facility specific requirements and recommendations based on their authorization basis and unique equipment and conditions, (e.g., equipment history, manufacturer warranties, operating environment, vendor O&M requirements and guidance, etc.).

Nuclear facilities and moderate to high hazard non-nuclear facilities will typically have additional facility-specific requirements beyond those presented in this Criterion. Nuclear facilities shall implement the requirements of DOE Order 433.1 (Ref. 10.3) (or 10 CFR 830.340, Maintenance Management, when issued) as the minimum programmatic requirements for a maintenance program. Additional requirements and recommendations for SSC operation and maintenance may be necessary to fully comply with the current DOE Order or CFR identified above.

Nuclear facilities and certain high hazard facilities (e.g. high explosive operations) may have additional facility specific requirements beyond those presented in this Criterion which are contained in the Safety Analysis Report (SAR), Technical Safety Requirements (TSR), or facility safety plans, as applicable.

6.0 REQUIREMENTS

Minimum requirements that Criterion users shall follow are specified in this section. Requested variances to these requirements shall be prepared and submitted to FM-MSE in accordance with LIR 301-00-02 (Ref. 10.4), "Variances and Exceptions to Laboratory Operations Requirements," for review and approval. The Criterion users are responsible for analysis of operational performance and SSC replacement or refurbishment based on this analysis. Laws, codes, contractual requirements, engineering judgement, safety matters, and operations and maintenance experience drive the requirements contained in this section.

6.1 Operator Requirements

- 6.1.1 Incidental Operator and Rigger must possess a current LANL Incidental Crane Operator and Rigger License.
- 6.1.2 Qualified Crane Operator and Rigger must possess a current LANL Qualified Crane Operator and Rigger license.
- 6.1.3 Person-in-Charge (PIC) must possess a current LANL Qualified Operator License.
Basis: LIR 402-1120-01.1 Cranes, Hoists, Lifting Devices and Rigging Equipment
- 6.1.4 Forklift truck operators must have basic training specified in DOE-STD-1090

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

6.2 Inspector Requirements

- 6.2.1** Crane Inspectors shall have completed a minimum of 80 hours of classroom training and be certified Level I, II, and III according to AP-16-00-205 (SSS Procedure, Qualifications of Inspection, Examination & Testing Personnel).

6.3 Operations Requirements

- 6.3.1** All critical lifts require a written Critical Lift Plan. Ordinary lifts may require a written ordinary lift plan as determined by the designated leader or operator/rigger.

Basis: LIR 402-1120-01.1 Cranes, Hoists, Lifting Devices and Rigging Equipment, Section 6.1.1.

- 6.3.2** All new, modified, reinstalled, or repaired cranes, hoists, or lifting devices shall be inspected by a qualified inspector, operationally tested per ASME B30 series (Operational Tests) and load tested at 110% of manufacturer's load ratings.

Basis: ASME B30 Series, DOE-STD-1090, LIR 402-1120-01.1

- 6.3.3** Operator inspections of cranes is based on the following definition of crane service:

- Normal Service – Operating at less than 85% of rated load and not more than 10 lift cycles/hr except for isolated instances.
- Heavy Service – Operating at 85 to 100% of rated load or in excess of 10 lift cycles/hr as a regular specified procedure.
- Severe Service – Operating at normal or heavy service under abnormal operating conditions (extreme temperatures, corrosive atmospheres).

Frequent visual inspections by the operator, records not required, are conducted as follows:

- normal service – monthly
- heavy service – weekly to monthly
- severe service – daily to weekly

Frequent inspections shall include observations during operations and include the following:

- Operating mechanisms for proper operation, adjustment, and unusual sound.
- Upper limit devices in accordance with ASME B30.16
- Leakage from hydraulic/air system
- Hooks and hook latches in accordance with ASME B30.10
- Hoists in accordance with ASME B30.16

Basis: ASME B30.17 Inspection, testing, and Maintenance

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

Periodic inspections by a qualified crane inspector, with records of conditions, are conducted as follows:

- a. normal service – yearly
- b. heavy service – yearly
- c. severe service – yearly

Periodic inspections shall include frequent inspection items plus the following:

1. deformed, cracked, or corroded members
2. loose or missing bolts, nuts, pins, or rivets
3. cracked or worn sheaves and drums
4. worn, cracked, or distorted parts such as pins, bearings, wheels, shafts, gears, rollers, locking and clamping devices, bumpers, and stops
5. excessive wear and brake system parts
6. excessive wear of drive chain sprockets and excessive drive train stretch
7. deterioration of controllers, master switches, contacts, limit switches, and push button stations
8. wind indicators for proper operation
9. gasoline, diesel, electric, or other power plants for proper operation
10. motion limit devices that interrupt power or cause a warning to be activated for proper performance. Each motion shall be inched or operated at low speed into the device with no load on the crane
11. controller function labels for legibility and replacement
12. hoists in accordance with ASME B30.16

The qualified crane inspector shall determine whether conditions found during inspection constitute a hazard and disassembly is required for additional inspection.

Basis: ASME B30.17 Inspection, testing, and maintenance

- 6.3.4** Cranes, hoists or lifting devices which have been idle for more than one month, but less than one year shall be subject to a frequent inspection prior to being placed in service. A periodic inspection is required for units idle more than one year.

Basis: ASME B30.17 Inspection, testing and maintenance

6.4 Maintenance Requirements

- 6.4.1** Any condition disclosed by the operation inspections (frequent/periodic) that is determined to be a hazard to continued operation shall be corrected by adjustment, repair, or replacement before continuing to use the unit.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

Basis: ASME B30 17 2.3 series

- 6.4.2** Adjustments, repairs, and replacements shall be performed by qualified personnel.
- 6.4.3** Components shall be adjusted or repaired as needed. Examples are; all operating mechanisms, limit switches, control systems, and brakes.
- 6.4.4** Chains and ropes shall be inspected, replaced, and maintained according to ASME B30.16

7.0 RECOMMENDATIONS AND GOOD PRACTICES

7.1 Operations Recommendations

- 7.1.1** Facility Management Personnel, Operators, and Inspectors should familiarize themselves with the DOE Hoisting and rigging manual (DOE STD-1090-2004) as well as LIR 402-1120-01.1 (Cranes, Hoists, Lifting Devices, and Rigging Equipment).

7.2 Maintenance Recommendations

- 7.2.1** A preventive maintenance program should be established. The program should be based on the recommendations outlined in the manufacturer's manual and for the application as reviewed by a qualified person. Dated history and records should be maintained.
- 7.2.2** All moving parts for which lubrication is specified should be regularly lubricated. Lubrication means should be checked for delivery of lubricant. Care should be taken to follow recommendations stated in the manufacturer's manual as to points and frequency of lubricant levels and types of lubricant. Wire rope is also a moving part and requires lubricant to prevent wear and corrosion.

Basis: ASME B30 section 17, 2.3.1. and 2.3.4

8.0 GUIDANCE

8.1 Operations Guidance

- 8.1.1** DOE Hoisting and Rigging Manual (DOE-STD-1090-2004) is an excellent source of guidance (and requirements) for hoisting and rigging operations.

8.2 Maintenance Guidance

- 8.2.1** The following KSL PMIs (Preventive Maintenance Instructions) have been reviewed by FM-MSE and are acceptable maintenance practices:
 - PMI 40-25-035 Inspection of fixed cranes and hoists
 - PMI 40-25-038 Inspection of lifting devices other than cranes
 - PMI 40-25-037 Inspection of monorail cranes

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

- PMI 40-25-034 Inspection of overhead and gantry cranes
- PMI 40-20-001 Mobile hydraulic crane maintenance, inspection and testing
- PMI 40-25-033 Crane Load Test Procedure
- PMI 40-25-036 Inspection of Jib Cranes
- PMI 40-25-001 Fixed Crane Maintenance, Repair, and Testing

8.2.2 Appendix A contains some typical examples of Crane Preventive Maintenance Programs.

9.0 REQUIRED DOCUMENTATION

Maintenance history shall be maintained for hoisting machinery, sheaves, hooks, chains, ropes, and other lifting devices to include, as a minimum, the parameters listed in the Table 9-1 below:

Table 9-1 Documentation Parameters

MAINTENANCE HISTORY DOCUMENTATION PARAMETERS				
PARAMETER	ML 1	ML 2	ML 3	ML 4
Maintenance Activities				
Repair / Adjustments	X	X	X	X
PM Activities	X	X		
Equipment Problems				
Failure Dates	X	X		
Failure Root Cause	X	X		
Inspection Results				
Inspection Date	X	X	X	X

Basis: Documentation of the parameters listed in Table 9-1 above satisfies the requirements of LPR 230-07-00, Criteria 2, (Ref. 10.5) which states; “Maintenance activities, equipment problems, and inspection and test results are documented.”

9.1 General Records

Maintain auditable records of all maintenance, repairs, tests and inspections.

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

10.0 REFERENCES

The following references, and associated revisions, were used in the development of this document.

- 10.1** LIR 230-05-01.0, Operation and Maintenance Manual.
- 10.2** DOE O 430.1A, Attachment 2 “Contractor Requirements Document” (Paragraph 2, Sections A through C), a requirement of Appendix G of the UC Contract.
- 10.3** DOE Order 433.1, Maintenance Management Program.
- 10.4** LIR 301-00-02.0, Variances and Exceptions to Laboratory Operation Requirements.
- 10.5** LPR 230-07-00, Maintenance History, Performance Criteria [2].
- 10.6** ANSI/ASME B30 Series
 - B30.1 Jacks
 - B30.2.0 Overhead and Gantry Cranes (Top Running Bridge, Multiple Girder)
 - B30.3 Hammerhead Tower Cranes
 - B30.4 Portal, Tower, and Pillar cranes
 - B30.5 Crawler, Locomotive, and Truck Cranes
 - B30.6 Derricks
 - B30.7 Base Mounted Drum Hoists
 - B30.8 Floating Cranes and Floating Derricks
 - B30.9 Slings
 - B30.10 Hooks
 - B30.11 Monorails and Underhung Cranes
 - B30.12 Handling Loads Suspended from Rotor Craft
 - B30.13 Controlled Mechanical Storage Cranes
 - B30.14 Side Boom Tractors
 - B30.16 Overhead Hoists (Underhung)
 - B30.17 Overhead and Gantry Cranes (Top Running Bridge, Single Girder, Underhung Hoist)
 - B30.18 Overhead Stacker Cranes (Top Running Bridge, Multiple Girder)
 - B30.19 Cableways
 - B30.20 Below the Hook Lifting Devices
 - B30.21 Manually Lever Operated Hoists
 - B30.22 Articulating Boom Cranes
- 10.7** ASME/PALD-12 Shop Cranes
- 10.8** DOE Hoisting and Rigging manual
- 10.9** LANL AR 13.2, Cranes, Hoists, Lifting Devices, and Rigging

LANL Operations and Maintenance Manual	Section 600
Criterion 601: Cranes Hoists, Lifting Devices, and Rigging	Date: 3/18/2005
Revision 1	

10.10 OSHA 1910.179 Overhead and Gantry Cranes

11.0 APPENDICES

Appendix A